भारतीय मानक
Indian Standard

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भूकृत्रिम — फुटपाथ संरचनाओं में आधार और उप-आधार परतों के रूप में इस्तेमाल ज्यौग्रिड के सुदृढ़ीकरण की स्थापना के लिए दिशानिर्देश

Geosynthetics — Guidelines for Installation of Geogrids Used as Reinforcement of Base and Sub-Base Layers in Pavement Structures

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Geosynthetics Sectional Committee, TXD 30

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Geosynthetics Sectional Committee had been approved by the Textile Division Council.

Geogrids are single or multi-layer materials usually made from extruding and stretching high density polyethylene or polypropylene or by weaving or knitting and coating high tenacity polyester yarns with polyvinylchloride (PVC). The resulting grid structure possesses large openings called apertures that enhance interaction with the soil or aggregate. The high tensile strength and stiffness of geogrids make them especially effective as soil and aggregate reinforcement. These can be uniaxial or biaxial. Biaxial geogrid is normally used for roadbed stabilization and reinforcement while uniaxial geogrid is commonly used for reinforcement of wall and earth retaining structures.

A large variety of detrimental factors such as environmental conditions, sub-grade conditions, traffic loading, utility cuts, road widening, ageing, etc contribute to an equally wide variety of pavement conditions and problems which need to be addressed in the maintenance or rehabilitation of the pavements, if not dealt with during initial construction. Pavement maintenance treatments are often ineffective and short lived due to their inability to both treat the cause of the problem and renew the existing pavement condition. The main cause of distress in pavements is that they are quite permeable with 30 to 50 percent of precipitation surface water infiltrating through the pavement, softening and weakening the pavement sub-grade and base thus accelerating pavement degradation. Existing pavement distress such as surface cracks, rocking joints and sub-grade failures cause the rapid reflection of cracking up through the maintenance treatment.

Therefore, the preferred strategy for long-term road and pavement performance is to build in safeguards during initial construction. These performance safeguards include stabilizing the sub-grade against moisture intrusion and associated weakening; strengthening road based aggregate without preventing efficient drainage of infiltrated water; and, as a last resort, enhancing the stress absorption and moisture proofing capabilities of selected maintenance treatments.

Geosynthetics (geogrids and geotextiles) are the most cost effective tools for safeguarding roads and pavements. Their four main applications in roads are sub-grade separation and stabilization, base reinforcement, overlay stress absorption and overlay reinforcement. Sub-grade stabilization and base reinforcement involve improving the road structure as it is constructed by inserting an appropriate geosynthetic layer. Sub-grade separation and stabilization applies geosynthetics to both unpaved and paved roads. Base reinforcement is the use of geosynthetics to improve the structure of a paved road. Both geotextiles and geogrids thus can play an important role in extending the life of a roadway system.

The general rules for use of geogrids and geotextiles in roadway system are as follows:

a) *Temporary Roads* — Used for hauling and access roads that are subject to low volume of traffic including working platform for permanent road construction:

   1) *Clayey or silty sub-grade with California Bearing Ratio (CBR) < 4* — If a clean base aggregate is used, then a non-woven separator geotextile shall be used. If a “choked aggregate” like general crusher run is used, then use either a geotextile or a biaxial geogrid that has good aperture stability and appropriate size for a design ESAL (Equivalent Single Axle Loading) less than 1 000, a woven geotextile designed for both separation and membrane roles – that is, consider the geotextile’s modulus. For larger ESAL, use a woven or non-woven geotextile designed simply for separation. The reinforcement role of the geogrid seems safe for approximately 10 000 ESAL.

   2) *Sandy sub-grade with CBR < 3* — Select a biaxial geogrid with good aperture stability and appropriate size or a woven geotextile that has a reasonable interface friction with the sand and the aggregate. If a woven geotextile is considered, care should be taken to ensure that it does not actually create a slick slip-plane beneath the aggregate.

(*Continued on Third Cover*)

Indian Standard

GEOSYNTHETICS — GUIDELINES FOR INSTALLATION OF GEOGRIDS USED AS REINFORCEMENT OF BASE AND SUBBASE LAYERS IN PAVEMENT STRUCTURES

1 SCOPE

This standard prescribes guidelines for installation of geogrids used as reinforcement of base and subbase layers in pavement structures

2 REFERENCE

The standard given below contains provision which, through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard.

IS No.	*Title*
IS 16341 : 2015	Geosynthetics — Standard practice for exposure and retrieval of samples to evaluate installation damage of geosynthetics

3 SURFACE PREPARATION

3.1 The geogrid shall be laid out smooth without wrinkles or folds on the prepared sub-grade in the direction of the construction traffic. Adjacent geogrid rolls shall be overlapped a minimum of 300 mm, ends of rolls shall be overlapped 900 mm. On curves, the material may be cut to conform to the curves. The overlap shall be in the direction of construction and shall be held in place by staples, pins or aggregate piles. Damaged areas shall be repaired by overlaying the area with sufficient material to overlap on all edges by at least 600 mm.

3.2 The aggregate base material shall be placed by end dumping onto the geogrid from the edge or over previously placed base aggregate. The construction equipment shall not be allowed directly on the geogrid. A minimum of 100 mm of aggregate shall be placed on the geogrid prior to the movement of construction equipment and turning movements shall be carefully monitored. Any ruts occurring during construction shall be filled with additional gravel aggregate and compacted to the specified density. If placement of the backfill causes damage to the geogrid, the damaged area shall be repaired as described above

3.3 Fill Placement Over Geogrid

Backfill shall be placed in minimum 150 mm lifts compacted to 95 percent standard proctor density. Backfill shall be placed in a manner that minimizes the development of wrinkles and/or movement in the geogrid. Construction equipment shall not operate directly on geogrid. A minimum of 300 mm of fill shall be placed prior to equipment operating on top of geogrid. Ends of geogrid rolls shall be spliced by the use of an extruded rod or bar of the same material as the geogrid, supplied by the geogrid supplier. Overlapping ends of geogrid rolls shall not be allowed in lieu of a mechanical connection.

3.4 The sub-grade soil shall be prepared as indicated on the construction drawings or a directed by the Engineer.

4 INSTALLATION

4.1 The geogrid shall be laid smooth without wrinkles or folds on the prepared sub-grade in the direction of construction traffic. Adjacent geogrid rolls shall be overlapped, sewn or joined as required in the plans Overlap shall be in the direction as shown on the plans or as given below:

Soil CBR (1)	*Method of Joining* (2)
Greater than 3	300 - 450 mm overlap
1 - 3	600 -1 000 mm overlap
0.5 - 1	1 000 mm overlap or sewn
Less than 0.5	Sewn
All roll ends	1 000 mm overlap or sewn

4.2 The base reinforcement geogrid shall be laid directly on the sub-grade. The reinforcement geogrid shall be laid beneath or within the base course as directed by the engineer.

4.3 On curves, the geogrid may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of fill or rock.

4.4 Prior to covering, the geogrid shall be inspected by a certified inspector of the engineer to ensure that the geogrid has not been damaged during installation. Damaged geogrid shall be repaired immediately. Cover the damaged area with a geogrid patch which extends an amount equal to the required overlap beyond the damaged area.

4.5 The subbase or base shall be placed by end dumping onto the geogrid from the edge of the geogrid, or over previously placed subbase or base aggregate. On soils with CBR>3, most rubber-tired vehicles can be driven at slow speeds, less than 16 km/h and in straight paths over the exposed geogrid without causing damage to the geogrid. Sudden braking and sharp turning should be avoided. Tracked construction equipment should not be operated directly upon the geogrid. A minimum fill soil thickness of 15 cm is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

4.6 For soils with CBR<1, construction vehicles shall not be allowed directly on the geogrid. The subbase or base shall be placed such that at least the minimum specified lift thickness shall be between the geogrid and equipment tires or tracks at all times. Turning of vehicles shall not be permitted on the first lift above the geogrid.

4.7 On sub-grades having a CBR value of less than 1, the subbase or base aggregate should be spread in its full thickness as soon as possible after dumping to minimize the potential of localized sub-grade failure due to overloading of the sub-grade.

4.8 Any ruts occurring during construction shall be filled with additional subbase or base material, and compacted to the specified density.

4.9 If placement of the backfill material causes damage to the geogrid, the damaged area shall be repaired as previously described above. The placement procedure shall then be modified to eliminate further damage from taking place.

4.10 The geogrid shall be laid at the proper elevation and alignment as shown on the construction drawings. The geogrid shall be installed in accordance with the installation guidelines provided by the manufacturer or as directed by the engineer. The geogrid may be temporarily secured in place with ties, staples, pins, sand bags or backfill as required by fill properties, fill placement procedures or weather conditions or as directed by the engineer.

5 GRANULAR BASE REINFORCEMENT

5.1 Place geogrid at the proper elevation and alignment as shown on the construction drawings. Provide minimum overlap per manufacturers recommendations. Install the geogrid in accordance with the guidelines provided by the manufacturer or as directed by the engineer. Geogrid may be temporarily secured in place with ties, staples, pins, sand bags or backfill as required by fill properties, fill placement, weather conditions, or as directed by the engineer.

5.2 Place, spread, and compact granular fill material in such a manner that minimizes the development of wrinkles in or movement of the geogrid.

5.3 A minimum loose fill thickness of 15 cm is required prior to operation of tracked vehicles over the geogrid. Keep the turning of tracked vehicles to a minimum to prevent tracks from displacing the fill and damaging the geogrid. Rubber-tired equipment may pass over the geogrid reinforcement at slow speeds (less than 16 kmph) when integrally-formed geogrids are used if sub-grade conditions permit. Do not use rubber-tired equipment directly on the geogrid when woven, multi-layer, or welded strip geogrids are used. Avoid sudden braking and sharp turning movements.

5.4 Replace at no additional cost to the Department any roll of geogrid damaged before, during, or after installation. Proper replacement consists of replacing the affected area and overlapping the geogrid one foot on all sides adjacent to the damaged area. IS 16341 for exposure and retrieval damages done during installation of evaluation samples.

6 INSPECTION

6.1 The owner or owner’s representative may randomly inspect geogrid before, during and after (using test pits) installation.

6.2 Any damaged or defective geogrid (that is frayed coating, separated junctions, separated layers, tears, etc) shall be repaired / replaced in accordance with **7**.

7 DAMAGE REPAIR

Any roll of geogrid damaged before, during and after installation shall be replaced by the contractor at no additional cost to the owner. Proper replacement shall consist of replacing the affected area adding 1m of geogrid to either side of the affected area.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Geosynthetics Sectional Committee, TX 30

Organization	*Representative(s)*
The Bombay Textile Research Association, Mumbai	Dr A. N. Desai (***Chairman***) Shri V. K. Patil (*Alternate*)
Business Coordination House, New Delhi	Shri Samir Gupta Shrimati Ritika Gupta (*Alternate*)
Central Road Research Institute, New Delhi	Shri Sudhir Mathur Shri Jai Bahagwan (*Alternate*)
Central Soil and Materials Research Station, New Delhi	Shri Nripendra Kumar Shri Manish Gupta (*Alternate*)
CIDCO, Mumbai	Representative
Coir Board, Kochi	Dr U. S. Sarma Shri M. Kumaraswamy Pillay (*Alternate*)
Department of Jute and Fibre Technology, Kolkatta	Dr Swapan Ghosh Shri K. R. Gupta (*Alternate*)
Directorate General of Supplies and Disposals, New Delhi	Additional Director General (QA)
E. I. Dupont India Pvt Ltd, Gurgaon	Shri R. Ganesh Shrimati Vedika Kapoor (*Alternate*)
Ganga Flood Control Commission, Patna	Shri S. Masood Husain Shri Ravi Bhushan Kumar (*Alternate*)
Garware Wall Ropes Ltd, Pune	Shri Tirumal Kulkarni Shri S. J. Chitnis (*Alternate*)
Gujarat Engineering Research Institute, Vadodara	Shri L. V. Ashara Research Officer (*Alternate)*
Indian Jute Industries’ Research Association, Kolkata	Shri P. K. Choudhury Shri Koushik Das (*Alternate*)
Indian Jute Manufacture Association, Kolkatta	Representative
Jaya Shree Textiles, Hooghly	Shri Pawan Sharma
Kusumgar Corporates, Mumbai	Shri Y. K. Kusumgar Dr M. K. Talukdar (*Alternate*)
Macaferri Environmental Solutions Pvt Ltd, Navi Mumbai	Dr Ratnakar Mahajan
Maharashtra Maritime Board, Mumbai	Representative
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Reliance Industries Ltd, New Delhi	Shri M. S. Verma Shri V. Ravikanth (*Alternate*)
Strata Geosystems (I) Pvt Ltd, Mumbai	Shri Narendra Dalmia Shri Shahrokh Bagli (*Alternate*)
Supreme Nonwovens Pvt Ltd, Hyderabad	Shri C. K. Chaudhuri Shri C. K. Jain (*Alternate*)
Techfab India, Mumbai	Shri Anant Kanoi Dr Saurabh Vyas (*Alternate*)

Organization	*Representative(s)*
The Synthetics & Art Silk Mills Research Association, Mumbai	Dr Manisha Mathur Shrimati Ashwini Sudam (*Alternate*)
Urja Products Pvt Ltd, Ahmedabad	Shri Janak Nanavaty
Veermata Jijabai Technological Institute, Mumbai	Shri S. P. Borkar
BIS Directorate General	Shri Prabhakar Rai, Scientist 'E' and Head (TXD) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri J. K. Gupta
Scientist 'C' (TXD), BIS

(*Continued from Second Cover*)

b) *Permanent Roads (ESAL>200 000)*
   1) *Clayey or silty sub-grade with CBR < 3* — Consider building a working platform using the temporary road methods upon which conventional road can be constructed.
   2) *Clayey or silty sub-grade with 3 < CBR < 8* — If there is any potential for degradation due to water intrusion, frost heave, etc. then include a separator geotextile to protect the base aggregate during these periods.
   3) *Sandy sub-grades with CBR < 3* — Use a biaxial geogrid that has good aperture stability and appropriate size to reinforce the base aggregate. This is particularly helpful when poor quality stone and small aggregate thickness is used, less than 25 cm.

A geosynthetic element that functions primarily as a separator (typically when the sub-grade CBR>3) will increase the allowable bearing capacity of the sub-grade by 40 to 50 percent. (*separation geotextile*). A geosynthetic element that functions primarily to provide confinement of the aggregate and lateral restraint to the sub-grade (typically when the sub-grade CBR<3) will both increase the allowable bearing capacity of the sub-grade and provide an improved load distribution ratio in the aggregate. The combined benefit can enhance load carrying capacity of the road by well over 50 percent (*stabilsation geogrids and geotextiles*) as a separator (typically when the sub-grade CBR>3) will increase the allowable bearing capacity of the sub-grade by 40 to 50 percent. (*separation geotextile*).

Geosynthetics can be also used as inter layers by placing them below or within the overlay (asphalt concrete) and are thus helpful in rehabilitating distressed road surfaces. These may also provide a moisture barrier.

Survivability is defined as resistance to mechanical damage during road construction and initial operation. The ability of a geosynthetic to survive installation and reasonable service loads shall be assured if it is to perform as designed. Installation damage to a geogrid is a function of the following:

a) Geogrid thickness,
b) Compactive effort and lift thickness,
c) Type and weight of construction equipment used for fill spreading,
d) Grain size distribution of backfill,
e) Angularity of backfill,
f) Polymer used in the manufacture of geogrid, and
g) Geogrid manufacturing process.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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